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Dated

6 August 2004

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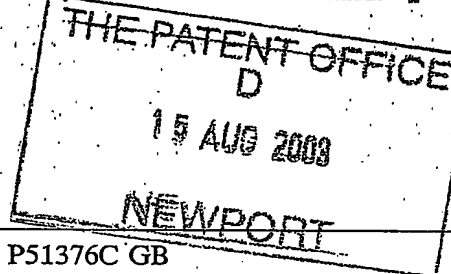


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Request for grant of a patent

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1. Your Reference

P51376C GB

2. Patent Application Number
(The Patent Office will fill in this part)

15 AUG 2003

0319222.6

3. Fill name, address and postcode of the or of each applicant (underline all surnames)

Tyco Electronics UK Limited
Faraday Road
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100/109 Industrial Estate
Shannon, County Clare
Republic of Ireland

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

England & Wales

8110918001
5117
17/21

4. Title of the invention

Arrangement for enclosing an object

8871865001

5. Name of you agent (if you have one)

Fry Heath & Spence LLP

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

The Gables
Massetts Road
Horley
Surrey RH6 7DQ

Patents ADP number (if you know it)

05880273001

8459554001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and (if you know it) the or each application number.

Country

Priority application number
(if you know it)

Date of filing
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application.

Number of earlier application

Date of filing
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

Yes

- a) any applicant named in part 3 is not an inventor, or
 - b) there is an inventor who is not named as an applicant, or
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Patents Form 1/77

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Continuation sheets of this form

Description 10

Claims(s) 4

Abstract 0

Drawing(s) 3

23 9

10. If you are also filing any of the following, state how many against each item.

Priority documents Nil

Translations of priority documents Nil

Statement of inventorship and right to grant of a patent (Patents Form 7/77) Nil

Request for preliminary examination and search (Patents Form 9/77) One

Request for substantive examination (Patents Form 10/77) Nil

Any other documents (please specify)

11. I/We request grant of a patent on the basis of this application.

Signature

Date

14 August 2003

12. Name and daytime telephone number of person to contact in the United Kingdom Anthony Clayton-Hathway 01865 841 060

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DUPLICATE

Arrangement for enclosing an object

The present invention relates to an arrangement for enclosing at least part of an object, especially an elongate object. The object may, for example, comprise one or more electrical or communications cables, e.g. a joint between two or more such cables, or a termination of such a cable.

Many methods are known for enclosing elongate objects such as cables. One class of methods is to provide an elastically expandable cover that has been expanded and is held on or in a support which retains the cover in its expanded state until the cover is allowed to contract around the cables, thereby enclosing them. Examples of methods in this class are described in international patent application WO 91/16564, US patent no. 5,753,861 and US patent no. 6,245,999 B1. A major problem associated with such methods is the general difficulty of removing the expanded cover from the support to enable the cover to enclose the cables. Because of this difficulty, some methods do not entail the removal of the cover from the support. However, while these methods solve the problem of how to remove the cover from the support they create other problems, namely of how to allow the cover to contract if the support is not removed from the cover, and how to accommodate the support in such cases.

In WO 91/16564, a recoverable elastomeric sleeve is provided in an expanded condition on a hollow cylindrical mandrel that has longitudinally extending projections spaced apart around the external circumference of the mandrel. The projections are intended to facilitate the withdrawal of the mandrel from the sleeve, and a lubricant may be provided to make such withdrawal easier. Even with such aids, withdrawal of the mandrel from the sleeve requires the manipulation of the mandrel, including rotating the mandrel within the sleeve in order to coat the internal surface of the sleeve with the lubricant. The presence of the lubricant between the contracted sleeve and the cable may not be desirable.

US patent no. 5,753,861 discloses an arrangement whereby an expanded sleeve is provided on a cylindrical support in such a way that the ends of the sleeve are folded back. In order to install the sleeve around a cable joint, the folded back ends of the sleeve are unfolded such that they extend beyond the ends of the support and thus contract around the cables. The support is therefore retained within the sleeve rather than being removed. Consequently, the problem of the difficulty of removing the support from the sleeve is obviated, but at the cost of retaining the support within the sleeve, and hence this arrangement might be regarded as a compromise.

In US patent no. 6,245,999 B1, the ends of the expanded sleeve are also folded back, but an inner holdout member on which the sleeve is provided includes a longitudinally extending slit by which the holdout member may collapse under the action of a radial contracting force. Consequently, the holdout member is retained within the sleeve, but in a contracted configuration. This arrangement might also therefore be regarded as a compromise.

The present invention seeks to provide an improved arrangement and kit for enclosing at least part of an object, e.g. an elongate object such as a cable (or more than one cable). The invention also provides improved methods for assembling the kit to provide the arrangement, and for enclosing the object by means of the arrangement.

Accordingly, a first aspect of the invention provides an arrangement for enclosing at least a part of an object, comprising an elastically deformable cover and a support by which the cover is held in a deformed state such that removal of the cover from the support allows the cover to relax and thereby to enclose an object, an initiating part of the cover being arranged such that the deformation of that part may be locally relaxed initially in isolation from that of the remainder of the cover, the arrangement being such that the local

relaxation provides an impetus to cause the remainder of the cover to relax in a way that facilitates or causes the removal of the cover from the support.

The invention has the advantage that by locally relaxing the deformation of a part (only) of the cover, the cover may substantially "self-install", i.e. automatically relax and be removed from the support with little or no manual assistance, thereby vastly easing the installation of the cover on the cable or other object.

Advantageously, a portion of the cover adjacent to the above mentioned initiating part of the cover may be in a more relaxed state than that of the initiating part of the cover, the relatively relaxed state of the relaxed portion of the cover at least contributing to the holding of the initiating part of the cover (and consequently also the remainder of the cover) in the deformed state. For example, whereas the initiating part of the cover is in a deformed (e.g. expanded and/or stretched) state due to the support, the adjacent portion of the cover may be in a partially or fully relaxed state due to an absence of the support or a smaller diameter (or other dimension) of the support next to the adjacent portion of the cover. Consequently, the relaxed adjacent portion of the cover may be folded over a part of the support, thereby retaining the initiating part of the cover in place on the support. By expanding (or otherwise deforming) the relaxed portion of the cover (e.g. manually) such retention of the initiating part of the cover may be released, thereby triggering the removal of the cover from the support.

When the initiating part of the cover is locally relaxed, potential energy stored in the initiating part of the cover due to the elasticity of the cover preferably is converted to kinetic energy that overcomes the inertia of the remainder of the cover and (especially) the frictional forces between the remainder of the cover and the support, thereby triggering the release of the remainder of the cover from the support, and the relaxation of the entire cover (such that it contracts, for example).

In preferred embodiments of the invention, the initiating part of the cover is held by the support in a state of greater deformation (e.g. greater expansion, and/or a stretched state) than that of the remainder of the cover. Preferably the greater deformation of the initiating part of the cover is caused by at least one protrusion and/or depression of the support, for example a flange and/or a groove on the support. Such a flange or groove may extend substantially entirely around the periphery of the support; additionally or alternatively, such a protrusion or depression may be localised at a single area on the support (and there may be more than one such area on the support).

An advantage of the initiating part of the cover being held in a state of greater deformation (which may be called "over deformation", or "over expansion") than that of the remainder of the cover, is that a greater amount of potential energy will be stored due to the elasticity of the cover, which may be converted to a greater amount of kinetic energy when the initiating part is locally relaxed. Consequently, the reliability of the removal of the cover from the support may be increased, or less (or no) manual assistance for the removal of the cover may be required.

In some embodiments of the invention, a protrusion or depression may be movable with respect to the remainder of the support, to cause or allow the local relaxation of the initiating part of the cover. For example, the protrusion or depression may be movable substantially to remove the protrusion or depression, i.e. substantially to flatten it out. This may be achieved by releasing a locking device, or some other trigger mechanism, for example.

The arrangement may include a retaining member attached to the cover such that releasing the retaining member from the cover causes or allows the local relaxation of the initiating part of the cover. For example, the retaining member may be in the form of a tie wrap (or similar) located around

the cover. The tie wrap or other retaining member may constrict the cover into a peripheral groove in the support, for example.

Preferably the cover is hollow and arranged to enclose at least part of an object (e.g. a cable or a cable joint) by encircling it. Most preferably, the cover is generally in the shape of a sleeve. The cover, in its relaxed state, may comprise a plurality of sections of differing shapes and/or sizes and/or configurations, each section arranged to enclose a respective section of the object. For example, the cover may be intended to enclose a cable "breakout" whereby the cores of a multi-core cable are separated, in which case the cover may include separate sections for each cable core, and a main section for the full diameter of the cable.

The cover preferably is formed from an elastomeric polymer material, for example a silicone elastomer.

In the arrangement, preferably all or part of the support is located inside the cover, thereby preventing the expanded cover from contracting until the support is withdrawn from the cover. The support preferably is hollow, thereby allowing the support to be placed around the cable or other object so that the cover may relax (e.g. contract) onto the object. The support preferably is formed from a polymer material, e.g. ABS (but other materials, including metals, are suitable). The support preferably is substantially rigid.

The support preferably has a shape that facilitates the removal of the cover from the support once the initiating part of the cover has been locally relaxed. For example, the support (or a part thereof) may be tapered (or chamfered) to facilitate the removal of the cover therefrom.

A second aspect of the invention provides a kit of parts for assembling an arrangement according to the first aspect of the invention, comprising the elastically deformable cover and the support.

A third aspect of the invention provides a method of assembling a kit according to the second aspect of the invention, comprising deforming the cover and holding the cover in its deformed state by the support.

The method preferably further comprises the step of deforming (e.g. stretching and/or expanding) the initiating part of the cover to a greater degree than that of the remainder of the cover, and holding the initiating part of the cover in its state of greater deformation by means of the support.

A fourth aspect of the invention provides a method of enclosing an object by means of an arrangement according to the first aspect of the invention, comprising:

- (i) placing the arrangement over the object;
- (ii) locally relaxing the initiating part of the cover; and
- (iii) causing or allowing the cover to be removed from the support and to relax and thereby to enclose the object.

Preferred embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, of which:

Figure 1 (views (a) to (d)) shows a preferred embodiment of an arrangement according to the invention, in the form of a cable breakout;

Figure 2 (views (a) to (d)) shows, schematically, a process of over deforming a part of the cover of an arrangement according to the invention (e.g. the arrangement illustrated in Figure 1), and subsequently locally relaxing that part of the cover such that it triggers the removal of the entire cover from the support;

Figure 3 (views (a) and (b)) shows, schematically, a movable protrusion of a support of a preferred embodiment of the invention; and

Figure 4 (views (a) and (b)) shows, schematically, parts of two further preferred embodiments of the invention.

Figure 1 shows a preferred embodiment of an arrangement 1 according to the invention. The arrangement 1 comprises an elastically expanded cover 3 held on a plurality of substantially rigid internal supports (or "holdouts"). The cover 3 is in the form of a cover for a cable breakout, and has a first main section 7 of relatively large diameter, and three minor sections 9 extending therefrom, of relatively small diameter. The main section 7 is for enclosing the end region of a three-core electrical power cable (not shown), and is held on a support 5 in accordance with the invention. The minor sections 9 are for individually enclosing the broken-out cores of the cable, and are individually held on separate conventional supports, or holdouts, 11.

A part 13 of the cover 3 extends over a peripheral flange 15 which projects radially outwardly from an end of the support 5, around an entire periphery of the support. It will be appreciated that in order for the elastically expandable cover 3 to extend over the flange 15 of the support, it has been stretched and expanded to a greater extent than has the remainder of the main section 7 of the cover 3. Adjacent to the initiating part 13 of the cover 3 is a portion 17 of the cover which is folded over the flange (and thus folded over the end of the cover). This adjacent portion 17 of the cover is therefore in a more relaxed state than that of the initiating part 13, and serves to retain the initiating part 13 in place on the flange 15 (and in its highly expanded and stretched condition).

In order to remove the section 7 of the cover 3 from the support 5, and allow the elastically expanded cover to relax and contract around the end of a cable, the adjacent portion 17 is merely expanded (preferably manually) sufficiently for the elasticity (i.e. the resilience) of the cover to cause the initiating part 13 of the cover to be released from the flange 15 and to relax

locally. This local relaxation of the initiating part 13 of the cover then provides an impetus to cause the remainder of the cover section 7 to relax in a way that causes (or at least facilitates) the removal of the cover section 7 from the support 5. Preferably the potential energy released as kinetic energy by the release of the over expanded and stretched initiating part 13 from the flange 15 causes the inertia of the cover section 7, but especially the frictional forces between the cover section 7 and the support 5, to be overcome, such that the elasticity of the cover section 7 forces the section 7 in the direction of the arrow A in view (c) of Figure 1. The support 5 (or at least its external surface) is tapered in the direction of arrow A, to aid this movement (known as "milk-off") of the cover section 7 from the support. In practice, the removal of the cover section 7 from the support 5 will generally be a combination of the cover moving away from the support 5 in the direction of arrow A, and the support 5 being forced out of the cover in the opposite direction, by the elasticity of the cover. If the cover is substantially prevented from moving longitudinally (in a bulk manner) so that it contracts around a cable located directly within the expanded cover, the support 5 will be forced to move away from the cover in a direction opposite to direction A.

As already mentioned, the three minor sections 9 of the cover 3 are individually held in an expanded state by means of respective individual supports 11. The supports 11 preferably are removed from the cover in a conventional manner merely by withdrawing them manually. This is generally possible because the smaller diameters of the sections 9 give rise to lower contracting forces opposing their expansion, and therefore the individual supports 11 are easier to remove than is the larger support 5. Even so, it is generally necessary to provide aids to their removal, such as the illustrated external ribs, and possibly also lubricant provided on the external surfaces. Such ribs and/or lubricant may also be provided on the exterior of the support 5, to aid the removal of the cover section 7 therefrom.

Views (a) to (d) of Figure 2 show, schematically, the main stages of the above described process of stretching the initiating part 13 of the cover around the flange 15, subsequently followed by triggering the release of the cover from the support by expanding the adjacent portion 17 of the cover. In view (a), the initiating part 13 is longitudinally stretched (in addition to its expansion to accommodate the support 5) so that it may extend over the flange 15. In view (b), the adjacent portion 17 is shown relaxing beyond the flange 15, thereby retaining the initiating part 13 in position on the flange in its "over deformed" state. View (c) shows the manual release (e.g. by finger 18) of the adjacent portion 17, leading to the relaxation of the initiating part 13 in view (d), which triggers the relaxation of the entire cover section.

Figure 3 shows: (a) cross-sectional, and (b) plan views of a movable protrusion 19 of a preferred arrangement according to the invention. In this arrangement, instead of (or in addition to) a fixed flange (or the like) one or more such movable protrusions are provided. The protrusion 19 functions in exactly the same way as the flange 15 of figures 1 and 2, but in this embodiment, in order locally to relax the initiating part 13 of the cover such that it triggers the removal of the cover from the support, a locking device 21 which locks the protrusion in its "protruding mode" is removed from the support (in the direction of arrow B) thereby allowing the expanded cover 3 to force the movable protrusion through the support such that it no longer protrudes significantly (i.e. its "non-protruding mode") and thus causing the cover to relax and become removed from the support.

Figure 4 (views (a) and (b)) schematically illustrates two embodiments of the invention which do not rely on an "over expansion" of the initiating part 13 of the cover. In each of these embodiments, the initiating part 13 near to an end of the cover is deformed no more (or not substantially more) than the remainder of the cover, but an adjacent portion 17 of the cover is folded over an end 23 of the support 5 (in view (a)) or over the lip 25 of a recess, or a reduced diameter section 27 of the cover (in view (b)) due to the elasticity of

the cover. By expanding the adjacent portion 17, the initiating part 13 of the cover is allowed to relax, thereby triggering the relaxation of the entire cover, and its removal from the support 5. For a given elasticity of the cover 3, the height H of the lip 25 determines the releasing force required to relax the initiating part 13 of the cover, and to trigger the recovery of the entire cover.

Claims

1. An arrangement for enclosing at least a part of an object, comprising an elastically deformable cover and a support by which the cover is held in a deformed state such that removal of the cover from the support allows the cover to relax and thereby to enclose an object, an initiating part of the cover being arranged such that the deformation of that part may be locally relaxed initially in isolation from that of the remainder of the cover, the arrangement being such that the local relaxation provides an impetus to cause the remainder of the cover to relax in a way that facilitates or causes the removal of the cover from the support.
2. An arrangement according to claim 1, in which a portion of the cover adjacent to the said initiating part of the cover is in a more relaxed state than that of the initiating part of the cover, the relatively relaxed state of the relaxed portion of the cover at least contributing to the holding of the initiating part of the cover, and consequently also the remainder of the cover, in the deformed state.
3. An arrangement according to claim 2, in which the local relaxation of the deformation of the initiating part of the cover may be caused by a deformation of the relaxed portion of the cover.
4. An arrangement according to any preceding claim, in which the initiating part of the cover is held by the support in a state of greater deformation than that of the remainder of the cover.
5. An arrangement according to claim 4, in which the greater deformation of the initiating part of the cover is caused by a protrusion and/or a depression of the support.

6. An arrangement according to claim 5, in which the protrusion is in the form of a flange and/or the depression is in the form of a groove.

7. An arrangement according to claim 5 or claim 6, in which the protrusion and/or the depression is movable with respect to the remainder of the support, to cause or allow the local relaxation of the initiating part of the cover.

8. An arrangement according to any preceding claim, further comprising a retaining member attached to the cover such that releasing the retaining member from the cover causes or allows the local relaxation of the initiating part of the cover.

9. An arrangement according to any preceding claim, in which the cover is hollow and arranged to enclose at least part of an object by encircling it.

10. An arrangement according to claim 9, in which the cover is generally in the shape of a sleeve.

11. An arrangement according to claim 9 or claim 10, in which the cover, in its relaxed state, comprises a plurality of sections of differing shapes and/or sizes and/or configurations, each section arranged to enclose a respective section of the object.

12. An arrangement according to any one of claims 9 to 11, in which all or part of the support is located inside the cover.

13. An arrangement according to any preceding claim, in which the support is hollow.

14. An arrangement according to any preceding claim, in which the object is an elongate object.

15. An arrangement according to claim 14, in which the elongate object comprises one or more electrical or communications cables.
16. An arrangement according to any preceding claim, in which the cover is formed from an elastomeric polymer material.
17. An arrangement according to any preceding claim, in which the support is formed from a polymer material.
18. An arrangement according to any preceding claim, in which the deformation of the cover comprises expansion of the cover.
19. An arrangement according to claim 4 or any claim dependent thereon, in which the state of greater deformation of the initiating part of the cover comprises a stretched and/or expanded state.
20. An arrangement according to any preceding claim, in which the support has a shape that facilitates the removal of the cover from the support once the initiating part of the cover has been locally relaxed.
21. An arrangement according to claim 20, in which the support is tapered to facilitate the removal of the cover therefrom.
22. An arrangement according to any preceding claim, in which the support carries lubricant material that facilitates the removal of the cover from the support once the initiating part of the cover has been locally relaxed.
23. An arrangement according to any preceding claim, in which the removal of the cover from the support is substantially automatic once the initiating part of the cover has been locally relaxed.

24. A kit of parts for assembling an arrangement according to any preceding claim, comprising the elastically deformable cover and the support.

25. A method of assembling a kit according to claim 24, comprising deforming the cover and holding the cover in its deformed state by the support.

26. A method according to claim 25 when dependent upon claim 4, further comprising the step of deforming the initiating part of the cover to a greater degree than that of the remainder of the cover, and holding the initiating part of the cover in its state of greater deformation by means of a suitable projection or other formation of the support.

27. A method of enclosing an object by means of an arrangement according to any of claims 1 to 23, comprising:

- (i) placing the arrangement over the object;
 - (ii) locally relaxing the initiating part of the cover; and
 - (iii) causing or allowing the cover to be removed from the support and to relax and thereby to enclose the object.
-

Fig. 1

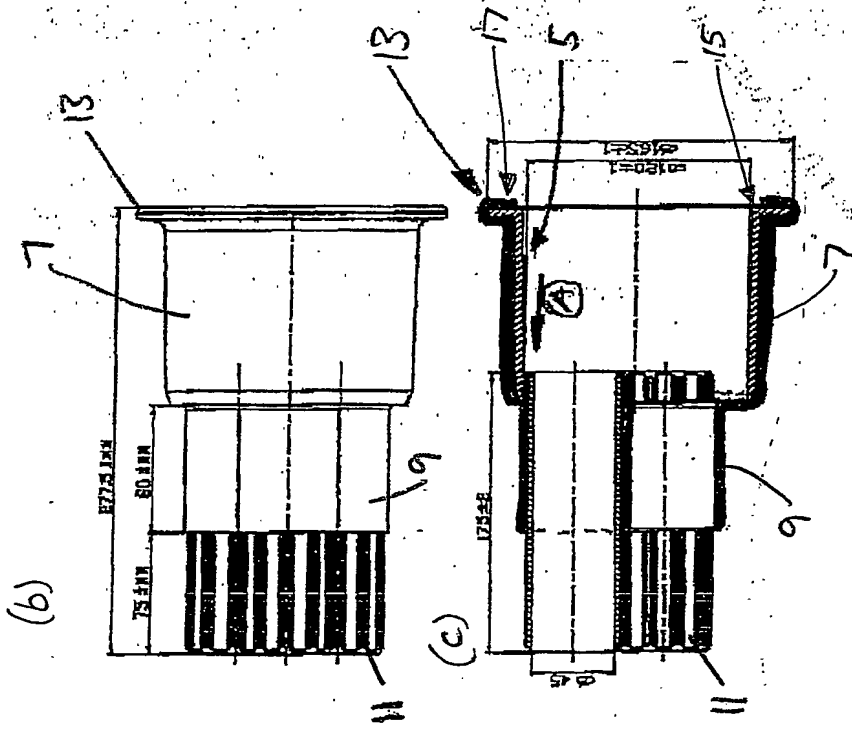
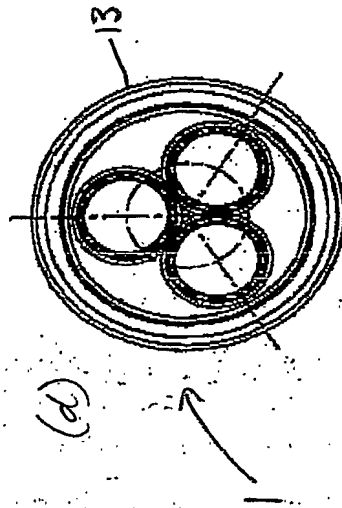
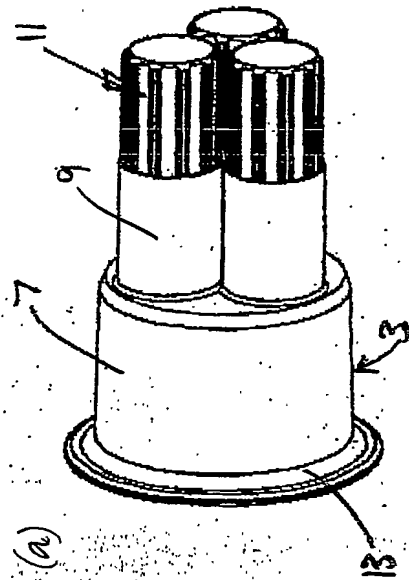


Fig. 2

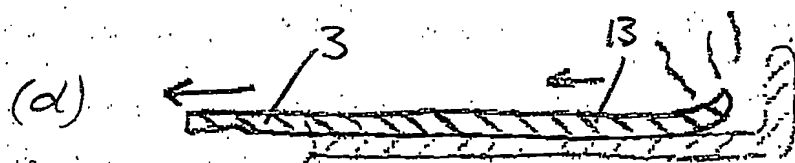
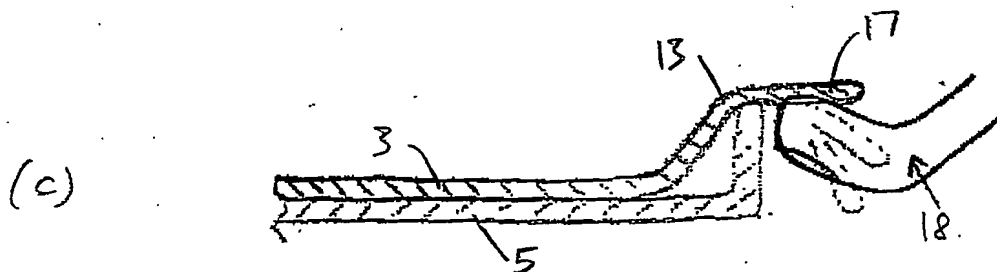
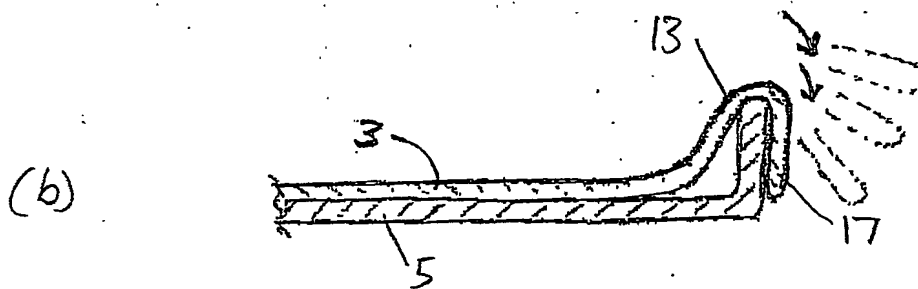
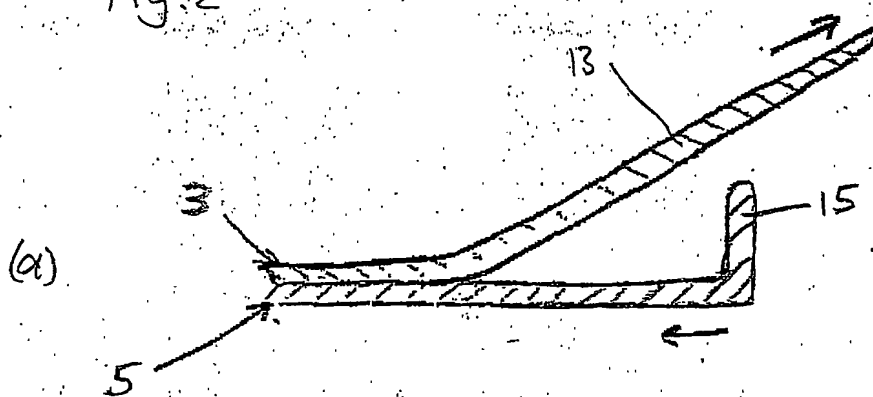


Fig. 3

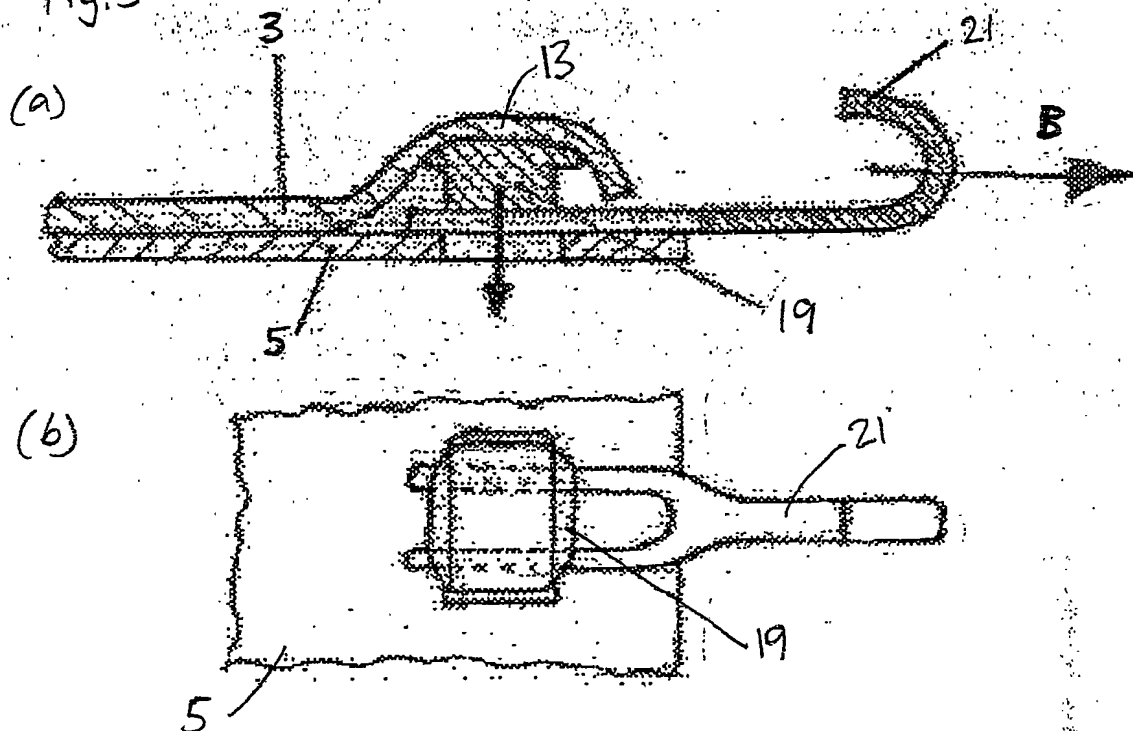
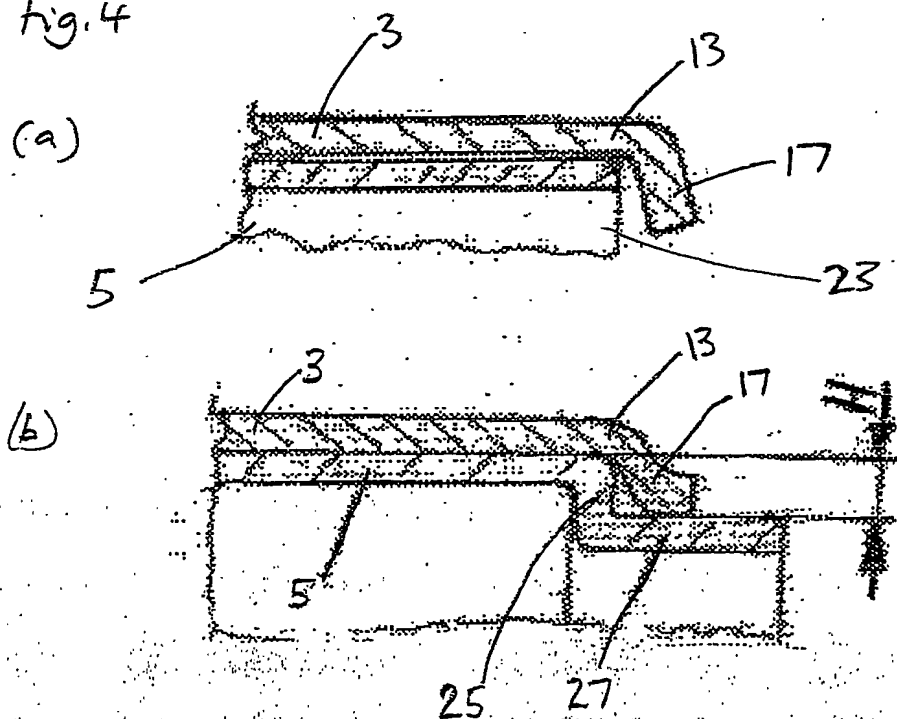


Fig. 4



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